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Meeting Record

IMS:	00-RU-0136
MEETING PURPOSE:	RU/BNFL Topical Meeting to discuss BNFL Integrated Safety Management (ISM) Cycle 1 Evaluation of Hazards, Control Strategies, Design Basis Events (DBE), and Standards Selection
MEETING DATE/TIME:	November 30, 1999/1:00 – 5:00 PM
MEETING PLACE:	Vernita Room, Red Lion Inn, Richland, WA
AGENDA:	1. RU Opening Remarks 2. BNFL discussion of its Integrated Safety Management Cycle 1 Evaluation of Hazards, Control Strategies, DBE, and Standards Selection
ATTENDEES:	See Attachment 1
PREPARED BY:	Ko Chen
CONCURRENCE:	George Kalman

KEY DISCUSSION ITEMS:

The meeting began with a welcome from the RU, the introduction of attendees (Attachment 1) and a review of the meeting agenda. The RU then briefly went over the transition issues since the October topical meeting (Attachment 2). The transition issues included the following:

- A preliminary meeting on the BNFL DBE selection process was held between BNFL and the RU on October 6, 1999.
- The BNFL ISM Cycle 1 topical meeting submittal was received by the RU on October 26, 1999.
- A level 1 meeting on the BNFL ISM Cycle 1 process was held between the RU and BNFL on November 2, 1999.
- The BNFL comments on September topical meeting minutes were received by the RU on November 8, 1999.
- The October topical meeting minutes were issued by the RU on November 9, 1999.

- An updated BNFL ISM Cycle 1 topical meeting submittal was received by the RU on November 16, 1999.
- A second level 1 meeting on the BNFL ISM Cycle 1 process topical meeting was held between the RU and BNFL on Nov. 18, 1999.

Status of ISA Open Issues and Questions

Open ISA questions Q. 44 and Q. 87 were closed based on the response presented in BNFL letter 007224, "…Closure of Initial Safety Analysis Report Open Items," dated Oct. 27, 1999. Both Q. 44 and Q. 87 were related to BNFL's definition of "Licensee Controlled Requirements".

The Current Status of ISA Open Issues and Questions

117 items are closed and 16 remain open. 66 of 117 closed items will be tracked during the review of the PSAR. The rest were closed permanently. The following are the remaining ISA open issues and questions:

Q. 102, Q. 31, Q. 92, A2, A3, A8, A9, A15, A18, C30, D10, D11, D12, D13, D14, D15

Status of Topical Meeting Action Items

19 action items remain open.

BNFL Review Comments on the September Topical Meeting Minutes

The RU accepts the following clarifications from BNFL:

- On page 4, Overview of Hydrogen Explosive Hazard, first paragraph, reword as follows: "BNFL stated that *the* control strategy for hydrogen explosive hazards *previously described* in its design safety features deliverable (DSF) to the RU *has evolved*. Following are the highlights of the strategy:"

- Page 6, Overview of Hydrogen Explosive Hazard, second and third full paragraphs, reword as follows: "The BNFL calculation showed that the unmitigated consequence for a hydrogen detonation will exceed TWRS-P radiation exposure *standards* for workers, co-located workers and the public. The unmitigated consequence for a hydrogen deflagration will exceed the TWRS-P radiation exposure limit for co-located workers. Responding to an RU question, BNFL replied that this calculation is based on a probability of one that the detonation or deflagration event will occur *given that* the hydrogen concentration reaches the appropriate limit."

  "At this point, the RU expressed the concern about BNFL's inconsistent application of decontamination factor (DF) value in consequence calculations. BNFL responded that a DF of 100 is used for *cell* retention when the consequence is calculated for workers. This is based on BNFL's Sellafield database. However, a DF value ranging from 1 to 5 will be used for building retention when the dose consequence is calculated for the public and co-located workers. This subject is under review by BNFL. BNFL will issue an updated report on dose assessment methodology by October 15, 1999."

BNFL Presentation

After this introduction by the RU, the BNFL portion of the program began. BNFL first responded to the RU criticism from level 1 meetings preceding the topical meeting that the code of practice and design guides were not followed during ISM Cycle 1 activities. BNFL stated that it had violated its own code of practice (K70C505) in the DBE selection process. BNFL wrote a deficiency report on the occurrence. Because of numerous instances of procedural violations, BNFL also initiated a root-cause analysis to remedy the situation. However, BNFL did not believe the procedural violations invalidated its ISM Cycle 1 results.

The subjects for the topical meeting were the BNFL Initial Selection of Hazard Control Strategies, DBE and Standards (Attachment 3), Summary of ISM Cycle 1 Pretreatment Results (Attachment 4), Summary of ISM Cycle 1 High Level Waste (HLW) Vitrification Results (Attachment 5), Summary of ISM Cycle 1 Low Activity Waste (LAW) Vitrification Results (Attachment 6), ISM Cycle 1 Standards Selection (Attachment 7) and the DBE Selection Methodology (Attachment 8).

Initial Selection of Hazard Control Strategies, DBE and Standards

BNFL stated that the primary objectives of this topical meeting were to provide the RU with the results of the first application of the ISM process and BNFL's preliminary list of DBEs for the facility. The objectives of ISM Cycle 1 process were:

- To identify hazardous situations, control strategies, safety requirements and standards.
- To identify an initial set of internal DBEs.
- To guide the development of the design.
- To learn more about ISM through its application to the development of the design.

BNFL stated it considered these objectives were largely achieved, except for the task of standards identification, which will be completed in Cycle 2. Through the ISM Cycle 1 process, BNFL stated it has achieved the following:

- The design guide for implementation of ISM has been developed.
- The need for changes to existing procedures and codes of practice has been identified.
- The standards identification process database (SIPD) has been developed.
- Knowledge had been developed and passed on through training.

BNFL further highlighted the following for its ISM Cycle 1 process:

- The ISM process was being implemented through an "integrated team approach". Integrated teams are multi-disciplinary and include representation from environment safety and health (ES & H), operations, design and functional engineering.
- The facility was divided approximately into 35 systems.
- Approximately 200 BNFL staff members participated in the process.
- Integrated team members were assigned by managers of different functions, i.e., design, safety etc.

For the task of hazards evaluation, BNFL stated that its integrated teams have achieved the following:

- Hazardous situations and hazards were identified for each system using a systematic "what if/checklist" approach.
- Hazards, initiators and hazardous situations were recorded in the SIPD.
- Bounding estimates of unmitigated consequences were made using the methodology given in the design guide and severity levels were assigned for each consequence.
- Severity Levels were used, in accordance with Appendix B of the SRD, to determine the number of barriers required to prevent and/or mitigate each hazardous event.
- In most cases, initiating event frequencies were estimated using the guidance in the design guide.

For the task of control strategy development, BNFL integrated teams proposed candidate strategies for each hazardous situation. The BNFL control strategy selection criteria include: effectiveness, demonstrability, practicality, reliability, regulation requirements, introduction of secondary hazards, impact on safety features for other hazards, passive or active, cost benefit, human factors etc. In principle, proven control strategies were adopted first. In situations where no proven control strategies existed, alternatives were proposed and evaluated. All preferred control strategies proposed by teams were recorded in SIPD. BNFL indicated more mitigative than preventive control strategies have been identified through its Cycle 1 process. BNFL stated ISM Cycle 2 will identify initiating events in more detail and will allow preventive control strategies to be identified.

BNFL stated it has not completed the task of standards selection in the Cycle 1 process. The objective was to select standards for each control strategy element related to each hazardous situation, and then rationalize this set to identify the bounding standards. BNFL also stated it considered more appropriate to select standards on the basis of the DBEs. In BNFL's view, this approach facilitates not only the tailoring of the standard but also, and more effectively, tailoring of the control strategies and hence the design itself.

A sample of BNFL ISM Cycle 1 results was presented at the meeting (Attachment 3). BNFL ISM Cycle 1 results can be summarized as follows:

- ISM Cycle 1 was carried out from June to October of 1999.
- The completion of Cycle 1 resulted in the identification of several thousand hazardous situations and their associated control strategies.
- Cycle 1 has identified the performance requirements for an initial set of important to safety systems, structures, and components (SSCs).
- The results of Cycle 1 have been fed into the design.
- Cycle 1 has facilitated the integration of safety, engineering and operations.

The following are the exchanges between the RU and BNFL on the subject with the RU comments and questions followed by the BNFL response:

- BNFL will revise its code of practice for the accident analysis process (K70C505), so the use of "risk factor" as discussed in the current code of practice will no longer be an element in its selection of DBEs. In Cycle 2, the BNFL methodology for selection of DBEs will be based on Figure 5-2 of the BNFL submittal to the RU.
- Was any training done for integrated teams before the hazard analysis process? No. However, all team members are familiar with the top-level DOE standards and process.
- How were the pretreatment, HLW, and LAW team integrated? There was little interface among teams during Cycle 1. But, this is expected to change in Cycle 2.
- Were there any operation-experienced staff involved in the process? 12 BNFL operational staff members participated in the process.
- Were all SL 1 accidents to the public defined as DBEs? Yes.
- Why is severity level for a hazard not listed as one of the criteria for the selection of the DBEs? It is embedded in the BNFL code of practice for accident analysis.
- BNFL stated most estimates of initiating frequencies and consequence results were made qualitatively based on engineering judgements in Cycle 1. However, all estimates will be made quantitatively in Cycle 2.
- BNFL stated cost/benefit is one of the selection criteria for DBEs. Was there any dollar amount associated with dose prevention for any control strategy? BNFL could not cite a specific cost/benefit criterion.
- Were any operating modes considered in Cycle 1? No, but they will be considered in Cycle 2.
- Will the ongoing changes to the facility design have a significant impact on Cycle 2 results? While it will have some impact, BNFL expects such changes to be minor since all major systems had been identified in Cycle 1.
- The RU commented that there is still a lack of technical detail and clarity in the information provided by BNFL. The current level of detail in the documents will not be sufficient for the submittal of the preliminary safety analysis report (PSAR). The RU will not be able to independently reproduce the results based on the current level of detail in the

BNFL submittals. BNFL acknowledged this, observing that the information was not yet developed to the PSAR level of detail.

Summary of ISM Cycle I Pretreatment Facility Results

In the BNFL ISM Cycle 1 process, a total of 1004, 991 and 988 hazardous situations were identified for workers, co-located workers and the public, respectively. An additional 144, 140 and 140 hazardous situations with undetermined consequences (TBD) were identified for workers, co-located workers and the public, respectively. The detailed listing of these hazardous situations is shown in Attachment 4. The following is a description of the hazardous situations with the most serious consequences:

- An acid/resin reaction in the Cesium (Cs) and Technetium (Tc) ion exchange (IX) columns will cause the most serious consequence for the public.
- The most serious accident consequences for co-located workers are: acid/resin reactions in the Cs and Tc ion exchange columns, flammable gas explosion in process tanks and/or ion exchange columns, tank boiling, IX column resin fire, and process vessel, piping, or pump leaks.
- The most serious accident consequences for facility workers are: acid/resin reactions in the Cs and Tc IX columns, flammable gas explosion in process tanks or IX columns, tank boiling, process vessel, piping or pump leaks, direct radiation exposure from mis-routes, sampling, and radiation exposure from process vessels.

Based on the hazards identified and its DBE selection methodology, BNFL stated a total of 84 DBEs were selected for the pretreatment facility. The DBEs with the most serious consequences are:

- Acid/resin reactions in the Cs and Tc IX columns.
- Flammable gas explosion in HLW receipt tank.
- Tank boiling in the Cs/Tc concentrate storage vessel.
- Resin fire in Cs IX columns.
- Pipe break between HLW six pack tank and feed tank, resulting in flooding of the process cell.
- Breakthrough in the Cs IX system resulting in transfer of inadequately treated LAW to LAW collection tank and high radiation exposure to facility workers.

The following are exchanges between the RU and BNFL on the subject with the RU comments or questions followed by the BNFL response:

- How was the number of DBE reduced from over 200 cited in the first topical meeting submittal to 120 in the second submittal to the RU? The number of DBE was reduced due to further screening and evaluation by BNFL.

- How many of the hazardous situations identified have consequences greater than 5000 Rem? BNFL was not sure.
- Why didn't criticality events and flammable gas detonation events show up as DBEs? Both events are still under evaluation and thus listed as those with "TBD" consequences. Furthermore, criticality events were being considered as incredible due to administrative controls on feed concentration. BNFL agreed that hazards and associated control strategies related to criticality events should be listed in the hazard identification table.
- Would the process of barium precipitation to remove sulfate generate a new significant safety issue? BNFL did not know and has not examined this possibility.
- BNFL stated seismic events were covered to a very limited extent in Cycle 1.
- What is the end product of the Cycle 1 process? The intended result was to complete the Cycle 1 process from hazard identification through standards selection. However, the standards selection was not completed in the Cycle 1. All other tasks completed from Cycle 1 have been documented. They will be used as the starting basis for the Cycle 2.

<u>Summary of ISM Cycle 1 Results for HLW Vitrification Facility</u>

A total of 316, 289 and 273 hazardous situations were identified for workers, co-located workers and the public respectively. An additional seven, four, and three hazardous situations were identified for workers, co-located workers and public respectively with undetermined consequences. A detailed listing was shown in Attachment 5. The following is the BNFL's description of hazards with the most serious consequences:

- Hydrogen detonation is considered to have the most serious consequence for the public.
- The following hazards are considered to have the most serious consequences for co-located workers: Hydrogen/sucrose detonation, off-gas release and leaks form vessels and pipes.
- The following hazards are considered to have most serious consequences for workers: Hydrogen/sucrose detonation, off-gas releases, leak from vessels and pipes, and direct shine.

Based on hazards identified and its DBE selection methodology, BNFL stated a total of 23 DBEs were identified for HLW facility. The following is BNFL's description of DBEs with the most serious consequences:

- Radiolytic hydrogen generation in Buffer Feed Vessel.
- Pressurization of the melter resulting in a release of off-gas to the cell.
- Combustion products damage the off-gas system and results in a release of off-gas to the cell.
- Failure of melter electrode and spill of molten glass.

The following are exchanges between the RU and BNFL on the subject with the RU comments or questions followed by the BNFL response:

- What is the radiation exposure duration assumed for co-located workers when radiological consequences were estimated? It is assumed to be either 2 hours or 8 hours depending on the case. However, a radiation exposure duration of 8 hours is assumed to be the upper limit for the process.
- Why are there more hazards with SL-1 and SL-4 than SL-2 and SL-3? Because of uncertainty and conservatism, many hazards were put in the SL-1 category. The two hazards with the consequences of SL-1 to the public were related to seismic events.
- What caused the 3 DBEs in the category of resuspension? These DBEs were related to load-drop accidents.

Summary of ISM Cycle 1 Results for LAW Vitrification Facility

231, 232 and 233 hazardous situations were identified for workers, co-located workers and public, respectively. An additional four, two, and two hazardous situations were identified for workers, co-located workers and public respectively with undetermined consequences. The detailed listing is shown in Attachment 6. The following is BNFL's description of hazards with the most serious consequences:

- Seismic events are considered to have the most serious consequences for co-located workers.
- The following hazardous situations are considered to have the most serious consequences for workers: Direct shine from Cs in glass containers, dropped glass container and spray leak from feed concentrate.

Based on hazardous situations identified and its DBE selection methodology, 12 DBEs were identified by BNFL for its LAW facility. The following is the description of DBEs with the most serious consequences:

- The melter feed concentration breakpot floods into vessel vent system.
- A full glass container is dropped into the pour cell from the handling cell.
- The melter off-gas vents into the melter cell due to either a large surge or a blocked film cooler.
- The pour system control failures result in a large glass spill into the pour cave.

The following are exchanges between the RU and BNFL on the subject with the RU comments or questions followed by the BNFL response:

- Would the new LAW design create any new safety issues? BNFL stated it did not know yet. An evaluation is in progress to determine that.
- Has any hazard been identified for the new sulfate removal process? BNFL stated the

hazard has not been evaluated.

ISM Cycle 1 Standards Selection

BNFL provided a detailed flowchart to show its standards selection process (Attachment 7). Although BNFL had not completed its standards selection in Cycle 1, it did provide an example of the selection process. BNFL showed a decision tree for the grouping of vessels to determine design and fabrication specifications, and indicated that the standards selection process had resulted in a tailored set of standards for conducting non-destructive tests (NDT) on welds. To summarize the current status of standards selection, BNFL stated the following:

- When a standard is selected, a comparison will be made to the SRD to determine whether a change is required.
- The selected standards will be reviewed by the BNFL Project Safety Committee.
- A revised set of standards will be proposed by the end of ISM Cycle 2.

The following are the exchanges between the RU and BNFL on the subject with the RU comments or questions followed by the BNFL response:

- Can BNFL cite any example application of tailoring of standards to the facility design? The BNFL facility with three separate buildings for pretreatment, LAW, and HLW respectively was a direct outcome of its tailoring based on seismic standards.
- Are there specific standards which BNFL wants to tailor? BNFL stated it was expected that ASME AG-1 Section BA for some hazards and ASME Section VIII for non-pressurized tanks would be appropriate to tailor.
- The RU commented that the established process for tailoring standards is limited to standards for nuclear, radiological and process safety standards under the purview of the RU. Standards promulgated by other agencies, i.e., EPA, Washington Department of Ecology, are subject to the requirements of these agencies.

DBE Selection Methodology

BNFL stated the following purpose and objectives of the DBE selection methodology:

- Identify a set of events that define bounding conditions, which establish the performance requirements for control strategies.
- Identify a set of events that demonstrate compliance with the radiation exposure standards.
- The set of DBEs should be large enough that the standards and requirements applied to the control strategies are tailored appropriately.
- The set of DBEs should be representative of the range of possible hazardous situations in the facility.
- The set of DBEs should be small enough to be manageable.

Based on the BNFL DBE selection methodology, a given DBE is representative of a given hazardous situation provided that:

- The release mechanism for the two events is similar.
- The dose consequences from the two events are similar, i.e., both are SL-1 events or SL-2 or SL-3 events etc.
- The initiators and frequencies for the two events are similar, i.e., both are in unlikely range or extremely unlikely range etc.
- The impact on the operating environment (temperature, pressure, humidity, chemistry, corrosion etc.) from the two events is similar.

In Cycle 1, BNFL established a relationship between hazardous situations identified and control strategies established to control those hazards. For each hazardous situation, there is a set of control strategies relied on to manage that hazardous situations and for each control strategy, there is a corresponding set of hazardous situations that place demands on the control strategy. Furthermore, the identified hazardous situations were grouped into 15 event categories, such as liquid spills, fires, explosions etc. The details are included in Attachment 8.

Based on the BNFL similarity criteria outline previously (for details, see Fig 5-2 of BNFL topical meeting submittal to the RU), a set of preliminary DBEs and associated control strategies were selected by BNFL. Each hazardous situation was reviewed. The selection of DBEs allows BNFL to tailor the standards and requirements applied to the SSCs that implement a given control strategy element.

The following are the exchanges between the RU and BNFL on the subject with the RU comments or questions followed by the BNFL response:

- Will control strategies be altered once DBEs are selected? No.
- BNFL stated it will revise its code of practice for the accident analysis process (K70C505) to reflect the fact that its DBE selection methodology does not use risk factors. Instead, it will follow the strategy based on Figure 5-2 of the submittal to the RU.
- BNFL stated that SL-1 events were separated into those with doses greater than 5000 Rem and those with less than 5000 Rem. This separation allowed for consideration of both prevention (which reduced the frequency of the events) and mitigation (which reduced the consequences of events).
- Are all Cycle 1 results maintained in the SIPD? Yes. The Cycle 1 results will be used as the basis for Cycle 2.
- Both the RU and the participant from Washington Department of Ecology noticed that the presentation only addressed radiological hazards. Chemical hazards were not considered.
- The RU noted that there were no DBEs associated with inadvertent criticality events. BNFL responded that criticality issues had been addressed during level 1 meetings.

Action Items

1. BNFL will provide the RU with information concerning on how BNFL will address chemical hazards, industrial health and safety issues.
2. BNFL will revise its Code of Practice for Development of Hazard Control Strategies and Identification of Standards (K70C514-0); and its Code of Practice for the Accident Analysis Process (K70C505-0) to reflect the methodology described in the topical report, as stated in the topical meeting.
3. BNFL will ensure the personnel performing Cycle 2 hazard and accident analysis are familiar with the revised codes of practice prior to conducting Cycle 2 process, as stated in the topical meeting.
4. BNFL will include specific treatment of control strategies to prevent or mitigate inadvertent criticality in the Cycle 2 process, as stated in the topical meeting.
5. BNFL will evaluate whether or not the barium precipitation process for sulfate removal introduces safety concerns.

INFORMATION EXCHANGED:

1. The RU meeting presentation material
2. BNFL handout on initial selection of hazard control strategies, DBEs and standards
3. BNFL handout on summary of ISM Cycle 1 pretreatment results
4. BNFL handout on summary of ISM Cycle 1 results for HLW vitrification
5. BNFL handout on summary of ISM Cycle 1 results for LAW vitrification
6. BNFL handout on ISM Cycle 1 standards selection
7. BNFL handout on DBE selection methodology

ATTACHMENTS:

1. The attendance list
2. The RU presentation material
3. BNFL handout on initial selection of hazard control strategies, DBEs and standards
4. BNFL handout on summary of ISM Cycle 1 results for pretreatment
5. BNFL handout on summary of ISM Cycle results for HLW vitrification
6. BNFL handout on summary of ISM Cycle 1 result for LAW vitrification
7. BNFL handout on ISM Cycle 1 standards selection
8. BNFL handout on DBE selection methodology